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GIN TRASH HANDLING WITH SMALL AIR PIPE

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INTRODUCTION

Gravity chutes, conveyor belts, screw conveyors, fans, and combinations of these devices are used for handling gin waste. Trash and dust must be dealt with in gins from: (1) Seed cotton cleaners and extractors, (2) driers, (3) extractor feeders, (4) gin stands, and (5) lint cleaners. Conveyor belts, augers and possibly one or more small fans are usually employed for getting the trash from these points in the gin into a pneumatic system which conveys it to a central locator. From this system it is discharged into an open trash pile, an incinerator, one or more cyclones, a dust house or some other form of settling chamber. A major problem is to separate the air and gin trash without creating a dust nuisance.

In modern gins the pneumatic trash handling system comprises one to four low-pressure high volume centrifugal fans with motors of from 20 to 100 h.p. and extensive sheet metal piping. These fans handle 5,000 to 20,000 cubic feet of air per minute and from 125 to 1,000 pounds of burs, trash and dirt per hour, depending upon the size and layout of the gin and harvesting practices. The collection of the waste and dust-ladened air requires large settling chambers or several cyclones.

Air pollution near gins has caused more and more complaints as residences and business establishments have surrounded many gins.[2/] Lawsuits have resulted from the dust nuisance. Fires from burning burs and trash have resulted in increases in insurance rates and, in some instances, insurance coverage has been refused by underwriters. Because of these problems, confronted by ginners, research at cotton ginning laboratories has been

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1/ Agricultural Engineers, Southwestern Cotton Ginning Research Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Mesilla Park, New Mexico.

2/ The Texas Cotton Ginners Association Special Bulletin No. 1, What We Know About Air Pollution Control.

directed toward improvements in the waste handling systems. This report deals with a small pipe system designed to reduce the power required to handle gin trash and to reduce the volume of dust laden air.

FANS AND AIR PUMPS

The common practice in cotton gins for handling trash is to use straight blade centrifugal fans which are capable of operating up to 18 inches of resistance pressure as measured on a U-tube water gauge. The sheet metal piping ranges in diameter from 8 to 14 inches and may be several hundred feet in length. Systems using pipes 4 to 5 inch in diameter and pressures of 1 to 3 pounds per square inch (27.74 to 83.22 inches of water) have been used for cotton seed[3/] and castor beans[4/]. With the small pipe system a high speed turbo-blower or a positive displacement air pump is required to obtain the required pressure. For short runs of piping a turbo-blower usually will provide the necessary pressure and volume but for long runs a positive displacement air pump may be required.

FEEDERS

Gin trash is introduced into conventional pneumatic systems through the feed intake of fans when on the suction side or by vacuum droppers when on the discharge side. Radial blade wheels are used in low pressure fans and in most instances the material to be conveyed passes through the fan. Turbo-blowers and positive displacement blowers are not designed to handle material in this fashion. It is necessary, therefore, to feed the material into the system by some other means and against the pressure developed by the fan or pump. Vacuum wheels and screws are customarily used for feeding small air pipe high pressure systems.

LABORATORY DEVELOPMENTS

In 1957 a small diameter pipe trash handling system was set up at the Southwestern Cotton Ginning Research Laboratory, Mesilla Park, New Mexico, to investigate the engineering aspects of conveying gin trash with small volumes of air under relatively high pressure. Some attempts were made to "fluidize" the trash but this proved impracticable. The experimental set-up consisted of a positive displacement blower driven by a 5 h.p. motor, a 4-inch air line from the pump discharge to a vacuum wheel dropper, and a 5-inch conveying pipe from the dropper discharge to a small cyclone collector. (Fig. 1.)

3/ Bennett, Charles A., and Franks, G. N. Cottonseed Handling with Small Air Pipe. U. S. Department of Agriculture Circular No. 768. Revised October 1953.

4/ Schoenleber, L. G., and Hurst, W. M. Performance of Castor Bean Hulling Plants, Agricultural Engineering 33(11):708-710-712. November 1952.

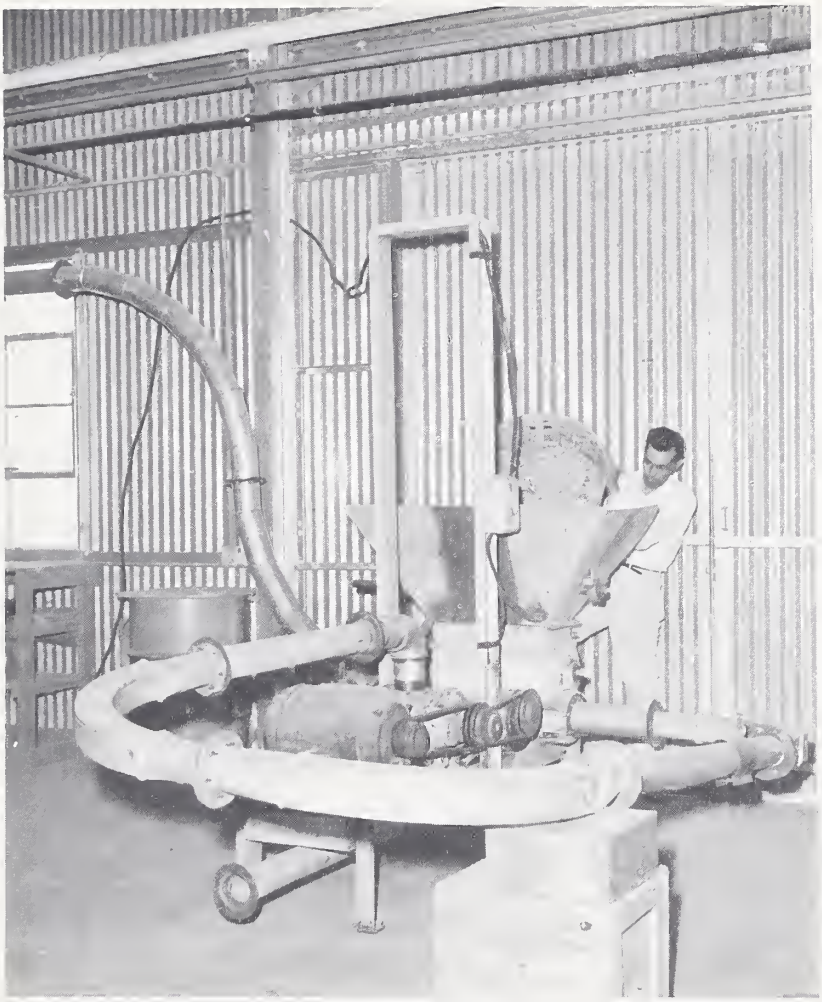

Figure 1. Experimental small pipe trash handling system under test in laboratory.

Two types of gin trash were handled through this system at three different speeds of the vacuum dropper. Three replications were run at each speed for the two kinds of trash: Extractor feeder trash consisting mostly of dry leaf with small amounts of burs and loose stems and large bur extractor trash that was practically all cotton burs with slight amounts of leaf trash and stems. The feeder trash weighed 6.75 pounds per cubic foot and the bur extractor trash weighed 4.5 pounds per cubic foot.

All air measurements were made in the 4-inch air line between the air pump and the vacuum dropper by means of a pitot tube and manometers. Air readings were taken with the system running, before and during the test run, for each test. The trash was weighed into cotton baskets in 100-pound lots and was fed manually into the hopper above the dropper at the maximum rate the system would take. Time was recorded for each test run.

The capacities obtained in the test and the calculated air velocities and volumes that resulted for each condition tested in the small diameter pipe trash handling tests are shown in Table 1. All data are averages of three replications. Also, calculated solid to air ratio (by weight) for each dropper speed is given. There were increases in volume in both types of trash handled by the system when the dropper speed was increased from 43 to 79 r.p.m. However, no further increase occurred in handling leaf trash when the dropper speed was increased to 118 r.p.m. Bur trash further increased in capacity with the higher dropper speed. There were only small differences in the air velocity in the pipe as the load changed, but static pressure increased from approximately 2.2 inches of water with no load to 13.6 inches of water when handling burs at the maximum capacity tested, and to 17.7 inches of water when handling feeder trash at the maximum capacity tested.

The capacity of the experimental small pipe system as shown by short duration tests was greater than that needed for most 5-80 or 5-90 saw gin plants. However, a short run of pipe was used and there was a tendency for coarse trash to clog the vacuum feeder. An auger plug feeding mechanism was designed and constructed to feed trash into a venture pick-up chamber. (Fig. 2.) Favorable results were obtained in the laboratory with the feeder and arrangements were made for setting up a small pipe system in a commercial gin for test purposes.

TEST IN COMMERCIAL GIN

Experimental gin trash handling equipment was installed in a commercial roller gin for studies during the 1960-61 ginning season. It was so arranged that the regular trash system of the gin remained intact for use when need arose, such as failure of the equipment or termination of the tests.

The auger plug feeder illustrated in figure 2 was installed in a trash line and fed by a cross auger. (Fig. 3.) Air was supplied by an air pump and the trash was moved to a collector through a 4-inch pipe. The air pump is not apparent in figure 3 but the 4-inch discharge pipe can be seen in the right foreground extending upward from an elbow.

The small pipe system as tested during the 1960-61 season received trash from seven roller gin stands. Seed cotton cleaning machinery for these gins consisted of one incline cleaner, one bur machine, and seven extractor feeder cleaners. The trash handled ranged from 200 to 500 pounds per hour and the test extended over a period of 3 weeks with satisfactory results.

Table 1. Results of small pipe trash handling tests, Mesilla Park, New Mexico, 1958.

Type of trash	Pump speed	Dropper speed	Air velocity in 5" pipe[1/]	Air volume	Avg. capacity lbs. of trash moved	Solid to air ratio by wt.[2/]	Static pressure
	r.p.m.	r.p.m.	f.p.m.	c.f.m.	lbs./hr.		ins.H_2O
Extractor feeder	1,445	43	2,890	393	6,683	3.97:1	15.6
Extractor feeder	1,445	79	2,816	383	8,450	5.16:1	17.6
Extractor feeder	1,445	118	2,853	388	8,153	4.91:1	17.7
Bur extractor	1,445	43	3,000	408	4,395	2.52:1	9.07
Bur extractor	1,445	79	3,022	411	5,340	3.04:1	10.8
Bur extractor	1,445	118	2,978	405	7,093	4.09:1	13.6

1/ Air velocity calculated from formula $V=k\sqrt{h_v}$ where K for the Mesilla Park altitude calculated to be an average of 3900.

2/ Solid to air ratio calculated on a basis of 14 cu. ft. of air per pound.

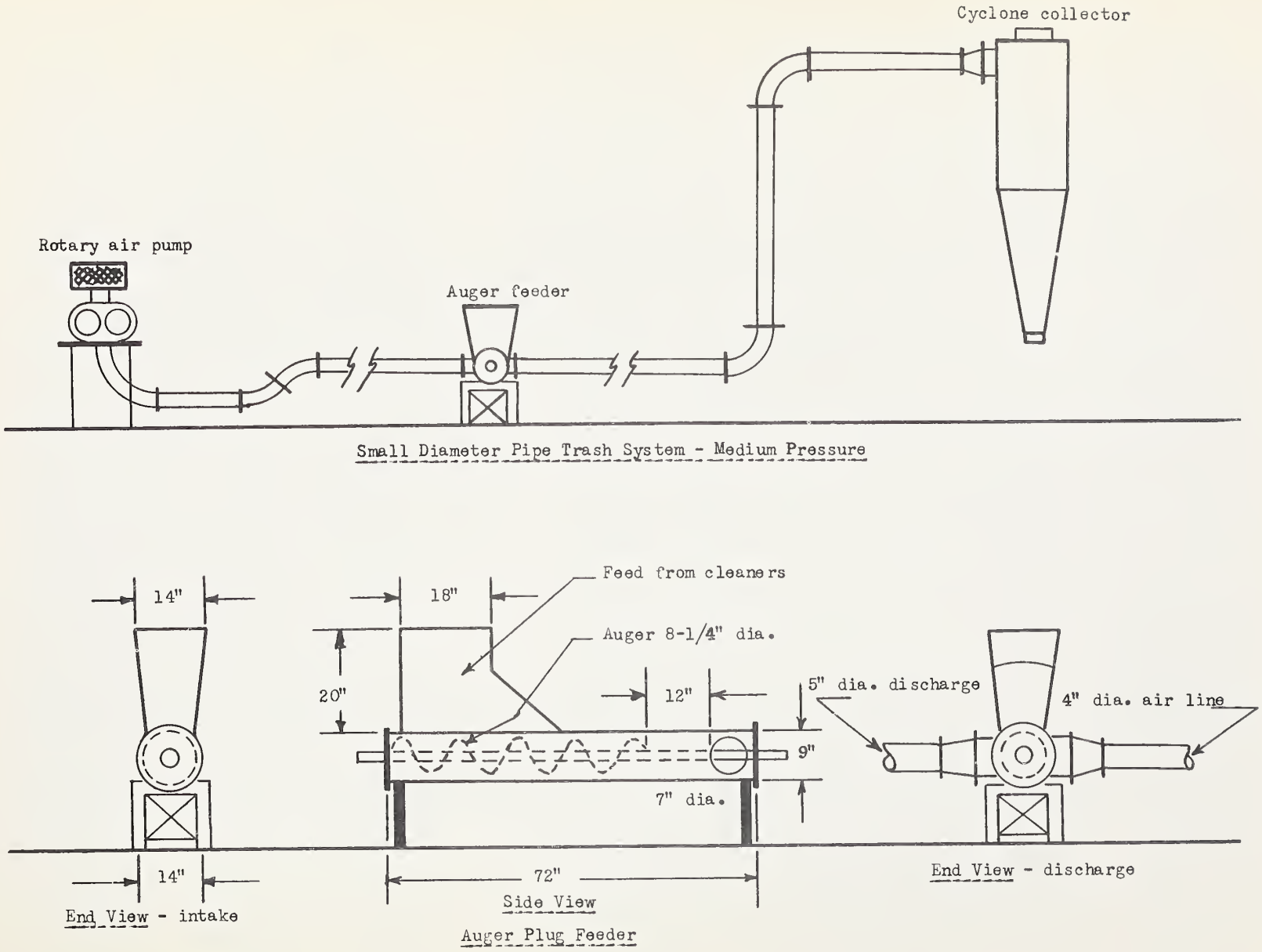

Figure 2. New trash handling system and auger plug feeder.

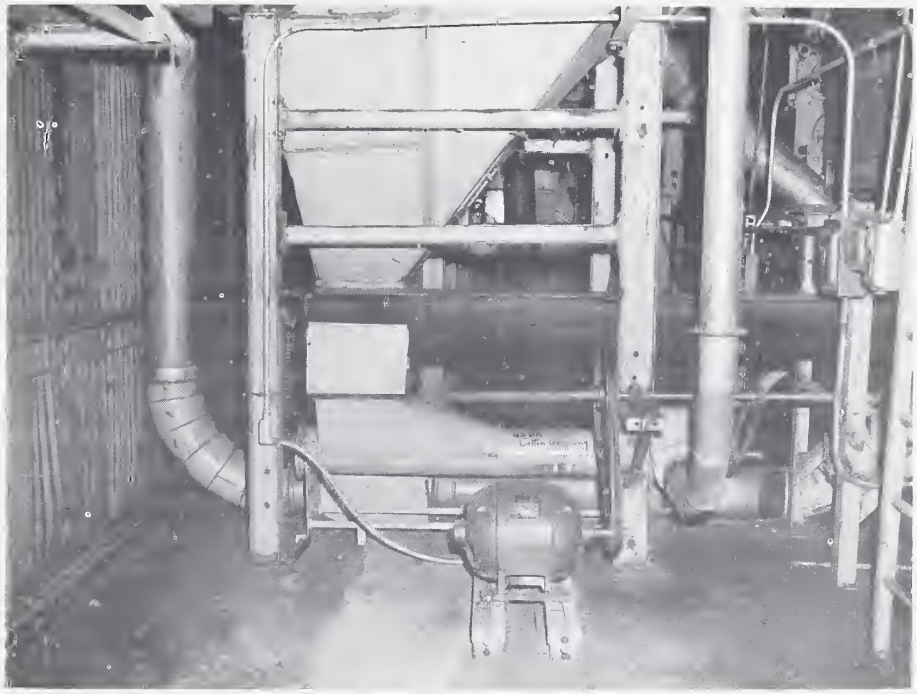

Figure 3. Small pipe trash handling system in commercial gin.

CONCLUSIONS

For some gins and in the design of new ones the small air pipe system for trash can be used to advantage. Results of tests in the laboratory and in a commercial gin show that gin trash can be moved with half or less power with the small-pipe pneumatic system than with the conventional air system, and that the volume of dust-ladened air is greatly reduced. In some gins, however, it would not be feasible to make the changes and alterations necessary in converting from the old to the new system.

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